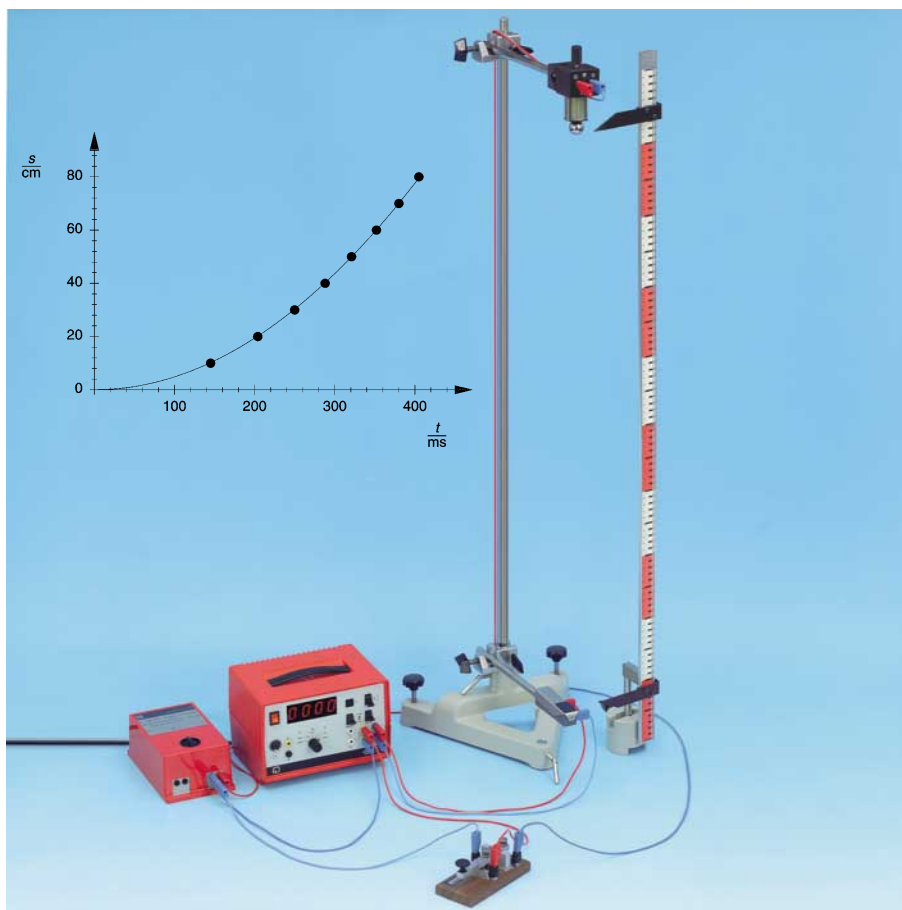


**P 1.3.5**

**Free fall**

P 1.3.5.1 Free fall: time measurement with the contact plate and the counter P

P 1.3.5.2 Free fall: time measurement with the forked light barrier and digital counter



Free fall: time measurement with the contact plate and the counter P (P 1.3.5.1)

To investigate free fall, a steel ball is suspended from an electro-magnet. It falls downward with a uniform acceleration due to the force of gravity

$$F = m \cdot g$$

$m$ : mass of ball,  $g$ : gravitational acceleration

as soon as the electromagnet is switched off. The friction of air can be regarded as negligible as long as the falling distance, and thus the terminal velocity, are not too great; in other words, the ball falls freely.

In the first experiment, electronic time measurement is started as soon as the ball is released through interruption of the magnet current. After traveling a falling distance  $h$ , the ball falls on a contact plate, stopping the measurement of time  $t$ . The measurements for various falling heights are plotted as value pairs in a path-time diagram. As the ball is at rest at the beginning of timing,  $g$  can be determined using the relationship

$$h = \frac{1}{2} g \cdot t^2.$$

In the second experiment, the ball passes one, or optionally two light barriers on its way down; their distance from the holding magnet  $h$  is varied. In addition to the falling time  $t$ , the obscuration time  $\Delta t$  is measured and, for a given ball diameter  $d$ , the instantaneous velocity

$$v_m = \frac{d}{\Delta t}$$

of the ball is determined. A velocity-time diagram  $v_m(t)$  is prepared in addition to the path-time diagram  $h(t)$ . Thus, the relationship

$$v_m = g \cdot t$$

can be used to determine  $g$ .

Cat. No.	Description	P 1.3.5.1	P 1.3.5.2 (a)	P 1.3.5.2 (b)
336 23	Large contact plate	1		
336 21	Holding magnet with clamp	1	1	1
200 67 288	Steel ball, 16 mm dia.		1	1
521 230	Low-voltage power supply, 3,6,9,12 V AC/DC,3 A	1		
575 451	Counter P	1		
504 52	Morse key	1		
575 48	Digital counter		1	1
578 51	STE Si diode 1 N 4007		1	1
337 46	Forked light barrier, infra-red		1	2
501 16	Multicore cable, 6-pole, 1.5 m long		1	2
311 22	Vertical scale, 1 m long	1	1	1
300 01	Stand base, V-shape, 28 cm	1	1	1
300 11	Saddle base	1	1	1
300 41	Stand rod, 25 cm	1	1	1
300 44	Stand rod, 100 cm	1		
300 46	Stand rod, 150 cm		1	1
301 01	Leybold multiclamp	2	1	1
309 48	Cord, 10 m		1	1
340 85	Set of 6 weights, 50 g each		1	1
501 35	Connecting lead, 200 cm, red, Ø 2.5 mm <sup>2</sup>	1	1	1
501 25	Connecting lead, 50 cm, red, Ø 2.5 mm <sup>2</sup>	1		
501 26	Connecting lead, 50 cm, blue, Ø 2.5 mm <sup>2</sup>	2	1	1
501 30	Connecting lead, 100 cm, red, Ø 2.5 mm <sup>2</sup>	1		
501 31	Connecting lead, 100 cm, blue, Ø 2.5 mm <sup>2</sup>	1		
501 36	Connecting lead, 200 cm, blue, Ø 2.5 mm <sup>2</sup>	1	1	1